Automation™

! IMPORTANT !
- For Your Safety -
Read this manual before
installing or using this equipment

ARC PRODUCTS AUTOMATION

DWF-4 TIG WIRE FEED SYSTEM
OPERATIONS AND SERVICE MANUAL

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THANK YOU!!!

. . . for purchasing **Arc Products** Equipment. Our commitment to you is to provide an ever expanding family of quality arc positioning equipment, controller and accessories. Please take a moment to read the following pages as they contain important information regarding proper use of this product and of welding/cutting safety and procedures.

WHOM DO I CONTACT		
For help? • Contact your distributor For additional information, such as Technical Manuals, Service, and Parts, Circuit and Wire Diagrams, User's Guides, Distributor Directories • Contact your distributor	**To file a claim for loss or damage during shipment?** • Contact your delivering carrier. For assistance in filing or settling claims, • contact your distributor and/or equipment manufacturer's Transportation Department	**How to contact Arc Products:** Call: 619-628-1022 Fax: 619-628-1028 sales@arc-products.com service@arc-products.com Arc Products Attn: Customer Service 1245 30th Street San Diego, CA 92154

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SAFETY

!IMPORTANT!

THIS MANUAL HAS BEEN DESIGNED FOR EXPERIENCED WELDING AND CUTTING EQUIPMENT OPERATORS AND MUST BE READ COMPLETELY BEFORE USING THIS EQUIPMENT. IF YOU LACK EXPERIENCE OR ARE UNFAMILIAR WITH THE PRACTICES AND SAFE OPERATION OF WELDING AND CUTTING EQUIPMENT, PLEASE CONSULT YOUR FOREMAN. DO NOT ATTEMPT TO INSTALL, OPERATE, OR PERFORM MAINTENANCE ON THIS EQUIPMENT UNLESS YOU ARE QUALIFIED AND HAVE READ AND UNDERSTOOD THIS MANUAL. IF IN DOUBT ABOUT INSTALLING OR OPERATING THIS EQUIPMENT, CONTACT YOUR DISTRIBUTOR OR THE CUSTOMER SERVICE DEPARTMENT OF Arc Products.

DEFINITIONS

Throughout this manual, NOTE, CAUTION, WARNING and DANGER are inserted to call attention to particular information. The methods used to identify these highlights and the purpose for which each is used, are as follows:

NOTE

Operational, procedural, and background information which aids the operator in the use of the machine, helps the service personnel in the performance of maintenance, and prevents damage to the equipment.

CAUTION

An operational procedure which, if not followed, may cause minor injury to the operator, service personnel and/or bystanders.

WARNING

An operational procedure which, if not followed, may cause severe injury to the operator, service personnel, or others in the operating area.

DANGER

An operational procedure which, if not followed, will cause severe injury or even death to the operator, service personnel or bystanders.

SAFETY INFORMATION

Safety is a combination of good judgement and proper training. Operation and maintenance of any arc welding and cutting equipment involves potential hazards. Individuals who are unfamiliar with cutting and welding equipment, use faulty judgement or lack proper training, may cause injury to themselves and others. Personnel should be alerted to the following potential hazards and the safeguards necessary to avoid possible injury. In addition, before operating this equipment, you should be aware of your employer's safety regulations.

BE SURE TO READ AND FOLLOW ALL AVAILABLE SAFETY REGULATIONS BEFORE USING THIS EQUIPMENT.

ELECTRIC SHOCK

THE VOLTAGES PRESENT IN THE WELDING AND CUTTING ENVIRONMENT CAN CAUSE SEVERE BURNS TO THE BODY OR FATAL SHOCK. THE SEVERITY OF ELECTRICAL SHOCK IS DETERMINED BY THE PATH AND THE AMOUNT OF CURRENT THROUGH THE BODY.

A) Install and continue to maintain equipment according to USA Standard C1, National Electric Code.

B) Never allow live metal parts to touch bare skin or any wet clothing. Use only dry gloves.

C) When welding or cutting in a damp area, or when standing on metal, make sure you are well insulated by wearing dry gloves, rubber soled shoes, and by standing on a dry board or platform.

D) Do not use worn or damaged welding or torch cables. Do not overload the cables. Use well maintained equipment.

E) When not welding/cutting, turn equipment OFF. Accidental grounding can cause overheating and create a fire hazard. Do not coil or loop the cable around parts of the body.

F) The ground cable should be connected to the workpiece as close to the work area as possible. Grounds connected to building framework or other locations remote to the work area reduce efficiency and increase the potential hazard of electric shock. Avoid the possibility of the cutting current passing through lifting chains, crane cables or other electrical paths.

G) Keep everything dry you might touch, including clothing, the work area, welding gun, torch and welding or cutting machines. Fix water leaks immediately. Do not operate equipment standing in water.

H) Never use a cutting torch or welding gun which is damaged or contains cracks in its housing.

I) Refer to AWS-Z49.1 for grounding

recommendations.

PERSONAL PROTECTION

SKIN AND EYE BURNS RESULTING FROM BODY EXPOSURE TO ELECTRIC-ARC WELDING AND CUTTING RAYS OR HOT METAL CAN BE MORE SEVERE THAN SUNBURN.

A) Use a proper face shield fitted with the correct filter (#10 or greater) and cover plates to protect your eyes, face, neck and ears from the sparks and rays of the cutting/welding arc when cutting/welding or observing cutting/welding. Warn bystanders not to watch the arc and not to expose themselves to the cutting/welding arc rays or to hot metal.

B) Wear flameproof gauntlet-type gloves, a heavy long-sleeve shirt, cuff-less trousers, high-topped shoes, and a welding helmet or cap (for hair protection) to protect the skin from arc rays and hot sparks or hot metal.

C) Protect other nearby personnel from arc rays and hot sparks with a suitable nonflammable partition.

D) Always wear safety glasses or goggles when in a cutting or welding area. Use safety glasses with side shields or goggles when chipping slag or grinding. Chipped slag is hot and may travel a considerable distance. Bystanders should also wear safety glasses or goggles.

E) Compressed gas cylinders are potentially dangerous, refer to the suppliers for proper handling procedures.

F) Wear ear plugs or other ear protection devices when operating cutting or welding equipment.

FIRE SAFETY

HOT SLAG OR SPARKS CAN CAUSE A SERIOUS FIRE WHEN IN CONTACT WITH COMBUSTIBLE SOLIDS, LIQUIDS OR GASES.

A) Move all combustible materials well away from the cutting area or completely cover materials with a nonflammable covering. Combustible materials include but are not limited to wood, clothing, sawdust, gasoline, kerosene, paints, solvents, natural gases, acetylene, propane, and similar articles.

B) Do not weld, cut or perform other hot work on used barrels, drums, tanks or other containers until they have been completely cleaned. There must be no substances in the container which might produce flammable or toxic vapors.

C) For fire protection, have suitable extinguishing equipment handy for instant use.

VENTILATION

WELDING AND CUTTING FUMES AND GASES, PARTICULARLY IN CONFINED SPACES, CAN CAUSE DISCOMFORT AND PHYSICAL HARM IF INHALED OVER AN EXTENDED PERIOD OF TIME.

A) At all times, provide adequate ventilation in the welding and cutting area by either natural or mechanical means. Do not weld or cut on galvanized, zinc, lead, beryllium or cadmium materials unless positive mechanical ventilation is provided to prevent inhaling fumes and gases from these materials.

B) Do not weld or cut in locations close to chlorinated hydrocarbon vapors coming from de-greasing or spraying operations. The heat of arc rays can react with solvent vapors to form phosgene, a highly toxic gas, and other irritant gases.

C) If you develop momentary eye, nose or throat irritation during welding or cutting, it is an indication that the ventilation is not adequate. Stop work and take the necessary steps to improve ventilation in the welding or cutting area. Do not continue to weld or cut if physical discomfort persists.

D) Use an air supplied respirator if ventilation is not adequate to remove all fumes and gases.

E) Beware of gas leaks. Welding or cutting gases containing argon are more dense than air and will replace air when used in confined spaces. Do not locate gas cylinders in confined spaces. When not in use, shut OFF the gas supply at its source.

F) Refer to AWS Standard Z49.1 for specific ventilation recommendations.

LOCATION OF EQUIPMENT

(Service Operating Conditions)

WARNING THE SMALL SIZE AND UNIQUE DESIGN OF AP AUTOMATION'S PRODUCT LINE REQUIRES THE OPERATOR BE AWARE OF CERTAIN SAFEGUARDS REGARDING THE PROPER PROCEDURE FOR PLACEMENT OF THE EQUIPMENT. GOOD JUDGMENT AND COMPLIANCE WITH YOUR PARTICULAR JOB SITE SAFETY REQUIREMENTS ARE ESSENTIAL. THE FOLLOWING SAFEGUARDS ARE RECOMMENDED.

NEMA Standard EW1-2.02 approved as ANSI C87.1-1976 outlines both usual and unusual service conditions for a welding power source. AP Automation products have been designed and manufactured to meet the usual service conditions as well as conform to the other NEMA standards. If an unusual service condition is required, Arc Products/AP Automation should be consulted.

A) INSTALLATION

Install the equipment in accordance with OSHA and National Electrical Code Standards, or other applicable standards.

B) COOLING

Locate the AP Automation Welding equipment so that airflow into the front and out of the back is not obstructed. Avoid placing the unit where dust or grinding particles will be directed into the unit.

C) ACCESS

Locate the AP Automation equipment where there is room for the operator to manipulate the controls or change the connections on either the front or the rear. Avoid placing the unit in a hallway or other area where foot traffic might be impeded.

D) SECURITY

Locate the unit where it can be secured to a platform, deck or other structure that is capable of safely supporting the unit and any other potential load.

PORTABILITY

WARNING THE SMALL SIZE AND UNIQUE DESIGN OF AP AUTOMATION'S PRODUCT LINE REQUIRE THAT THE OPERATOR BE AWARE OF CERTAIN SAFEGUARDS CONCERNING THE MOVEMENT OF THE EQUIPMENT. GOOD JUDGMENT AND COMPLIANCE WITH YOUR PARTICULAR JOB SITE SAFETY REQUIREMENTS ARE ESSENTIAL THE FOLLOWING SAFEGUARDS ARE RECOMMENDED:

A) In lifting and carrying a power source *it* is recommended that two people be used. The unit is designed to be lifted using a suitably rated and inspected choker (made of rope or nylon) run through both handles. Refer to the applicable OSHA standards or contact AP Automation for any questions regarding the lifting of this unit. Accessory units of less than 25 lbs. may be safely lifted by one individual.

B) Never drag, pull or lift the unit by the cables. Always lift the unit using the handles provided.

C) Never move the unit to a position that would allow its input and output cables to impede or block foot traffic.

D) Move and lift the unit in accordance with OSHA job site standards.

E) Do not allow the unit to remain operating when lifting or moving it.

F) Never move a power source unless all 10 flange screws and nuts holding the top and bottom cases are tight.

G) Do not lift a power source/wire feeder combination when the wire feeder is mounted to the power source handles. Always disassemble the wire feeder from the power source before lifting.

DANGER ANY TIME AP AUTOMATION EQUIPMENT IS PLACED ABOVE GROUND LEVEL, THE POTENTIAL HAZARD OF THE UNIT FALLING EXISTS.

SAFETY PRECAUTIONS AROUND ARC POSITIONING SYSTEMS

AP Automation equipment employs the use of moving electromechanical components to position the weld head and torch. Operators should exercise caution when working with moving equipment. Care should be taken not to allow loose clothing, jewelry or hair to get caught in the equipment causing injury. All automated systems should be turned off and have AC power positively disconnected before maintenance or repair.

SAFETY REFERENCES

The following publications provide additional information on important welding safeguards.

A) ANSI/ASC Z49.1-1988, American National Standard "Safety in Welding and Cutting".

B) Bulletin No. F4-1, "Recommended Safe Practices for the Preparation for Welding and Cutting Containers and Piping that have held Hazardous Substances".

C) OSHA Safety and Health Standards, 29CFR 1910, available from the United States Department of Labor, Washington, DC 20210.

D) NFPA Standard 518, "Fire Prevention in Use of Cutting and Welding Processes", available from the National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 0021 0.

E) NEMA Standards Publication/No. EW1-1989, Electric Arc-Welding Apparatus, approved as ANSI C87.1-1989. Available from National Electrical Manufacturers Association, 155 E. 44th Street, New York, NY 10017.

GENERAL INFORMATION

INTRODUCTION

AP AUTOMATION cold wire feed systems are designed for accurate application of filler wire into the weld or braze area. The DWF-4 is designed to be used for GTAW and PAW processes. The AP AUTOMATION Digital Wire Feeder System is made up of a positive feeding wire drive with a zero backlash 3-axis wire manipulator. This combination of components produces exceptionally good wire feeding characteristics. Systems will accommodate wire sizes from .020" dia. (.50mm) to .094" dia. (2.39mm) and feed at an adjustable rate, continuously variable from 0 to 300 inches per minute. A standard DWF-4 system is shown in Figure 1.1.

CONTROL UNIT

The control unit uses solid state circuitry in its motor supply and control circuits and operates from a 115/230 V.A.C., 50/60 Hz line supply. Provisions have been made for forward or reverse jog to allow easy pre-positioning of the filler wire. Start of wire feed and control of speed may be accomplished manually, from the front panel, or remotely, through the interface connector located on the rear panel. The speed at which the wire will feed is pre-set through use of the “PUSH TO SET” function on the front panel and can be controlled within .10" per minute increments. A digital readout of wire speed is provided. Start delay and stop delay timers are also provided for cycle control. Timers can be pre-set within .10 sec. intervals from 0 to 9.9 seconds.

WIRE DRIVE UNIT

The wire drive unit uses urethane rollers to grip the wire and feed it in either direction depending on the signals from the control unit. These rollers eliminate the need to change rollers when changing wire sizes from .020" (.50mm) dia. through .062" (1.57 mm) dia. wire. Special rollers are required for .094 (2.39mm) dia. wire. All wire can be loaded into the drive while it is operating. There is no need to hand-feed the wire through the mechanism before operating. Inlet and exit guides are provided with the wire drive. one inlet guide covers the entire range of wire sizes from .020" dia. (.50mm) to .094" (2.39 mm) dia. Three exit guides cover the range of wire diameters. Two of the exit guides are for the .020" through .062" range. The third is for the .094" wire. The guides are stored inside the drive housing. If a drive for .020" -.062" wire is ordered then two exit and one inlet guide will be supplied. If a drive for .094" is ordered, then one exit and one inlet guide will be supplied.

WIRE GUIDE ASSEMBLY

The wire guide assembly used with the DWF-4 wire drive unit consists of a guide mechanism, conduit, liners, and tip. The guide mechanism is constructed to allow full position adjustment for vertical, cross seam, feed angle and distance from the electrode. Tips and liners can be changed to suit the wire size being used (see information listed in Table 1.1) Standard length of the conduit supplied with the system is 36" (914.4mm). The length may be shortened by following steps 2.5.1 through 2.5.4 in the installation section.

Table 1, Wire Guide Details

WIRE SIZE	ROLLER	EXIT GUIDE	LINER	GUIDE TIP
.020" DIA (0.50mm)	1066-0084	1070-0051	2360-0951	1076-0038
.030" DIA (0.76mm)	1066-0084	1070-0051	2360-0951	2360-0137
.035" DIA (0.89mm)	1066-0084	1070-0051	2360-0951	2360-0137
.045" DIA (1.1mm)	1066-0084	1070-0051	2360-0951	2360-0145
.062" DIA (1. 5mm)	1066-0084	1070-0086	2360-0960	2360-0153
.094" DIA (2. 39mm)	1066-0092	1070-0116	NONE	2360-0099

You may also order a combination of the wire guide mechanism, tip, conduit assembly, and conduit liner together, as follows:

WIRE SIZE	PART NUMBER
.020" DIA (.50mml	1060-0022
.030-.035" DIA (.76-.89mml	1060-0031
.045" DIA (l.lmml	1060-0049
.062" DIA (1.5mml	1060-0057
.094" DIA (2.39mml	1060-0065
.020-.062" DIA (.50-1.5mm)	1060-0171*

***This includes all tips necessary for operation from .020" DIA through .062" DIA in one package.**

INSTALLATION

GENERAL SET-UP

A standard AP Automation DWF-4 system is illustrated in Figure 2.1 with the necessary interconnections shown for a typical installation. The parts are listed below:

Table 2, DWF-4 Components

	DWF-4 (.020-.062)	DWF-4 (.094")
Control Unit	0600-0217	0600-0217
Wire Drive Unit	1060-0006	1060-0014
Wire Guide Assembly	1060-0171	1060-0189

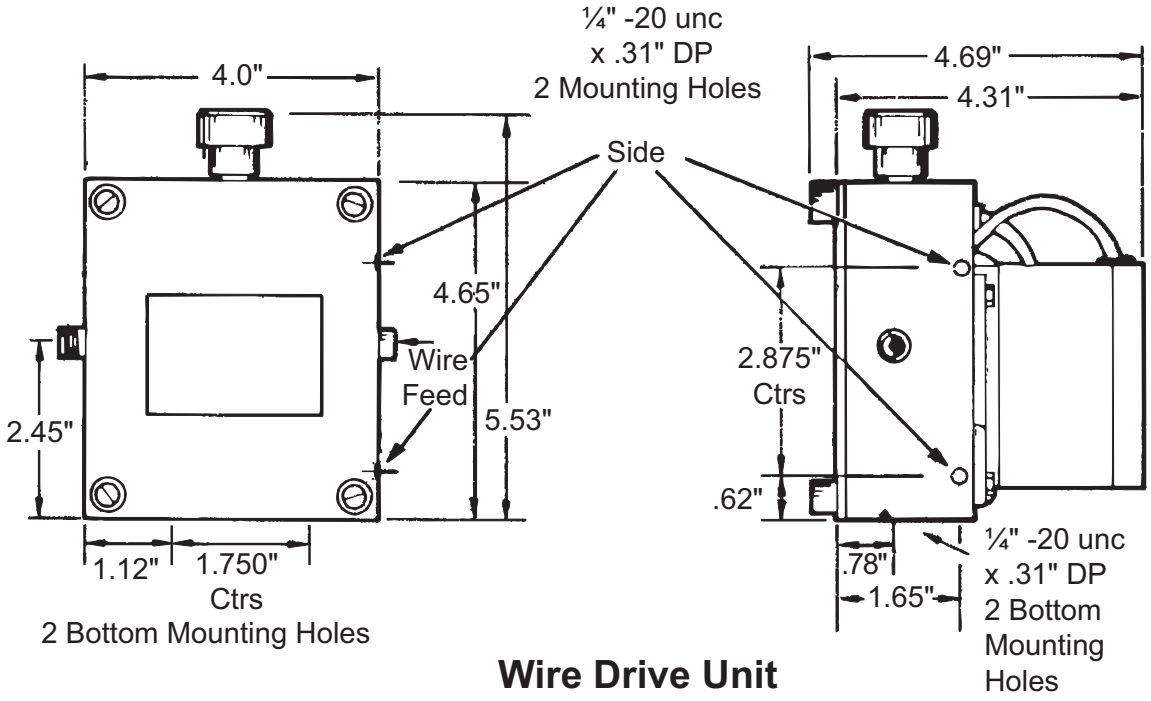
CONTROL UNIT LOCATION

The control unit should be placed in a location that provides easy access to the controls and proper air ventilation for cooling. Adequate ventilation is provided by maintaining a minimum of 5" (127mm) of unrestricted space between the control unit sides and rear and the nearest obstruction. The location should be selected to minimize any dust, dirt, moisture or corrosive vapors the control unit could be subjected to. Control unit outline dimensions are given in Figure 2.2.

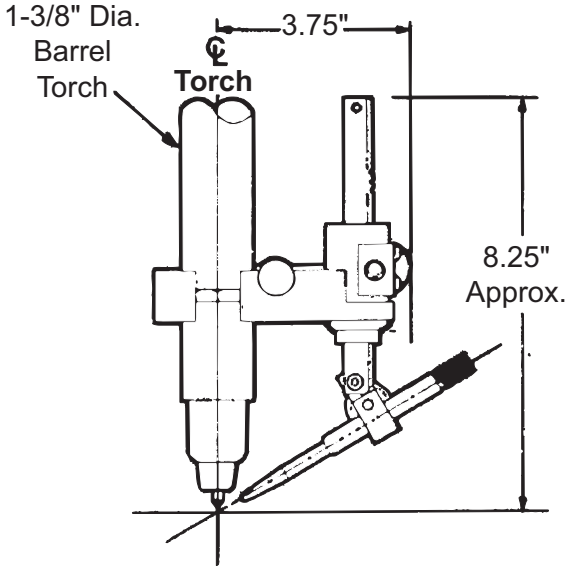
CAUTION THE CONTROL UNIT CAN OPERATE ON EITHER 100/120 VOLTS OR 208/230 VOLTS AC, 50 OR 60 HZ. BE SURE TO SELECT THE PROPER INPUT VOLTAGE ON THE REAR PANEL BEFORE CONNECTING TO POWER.

WIRE DRIVE UNIT MOUNTING

Figure 4 is an outline and a mounting dimension guide. The drive unit may be mounted using the inlet guide surface or the bottom surface (opposite the adjusting knob) through use of the existing tapped holes in the housing. The wire drive exit guide has a 7/16- 20 UNF external thread for mating with the supplied wire guide conduit for a DWF-4 system.



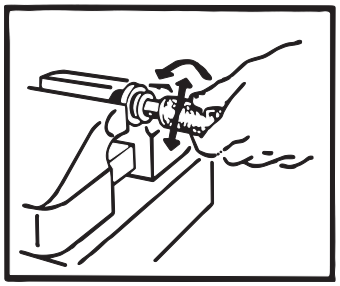
Wire Drive Unit

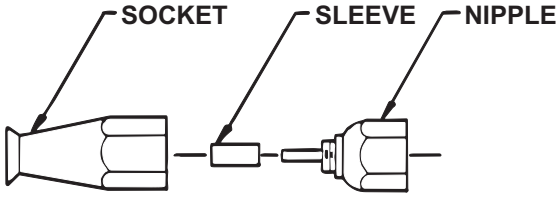


Wire Guide Manipulator

Figure 4, Wire Drive Unit and Wire Guide Manipulator Dimensions

CAUTION IN APPLICATIONS WHERE HIGH FREQUENCY OR CAPACITIVE DISCHARGE START IS USED THE DRIVE HOUSING SHOULD BE GROUNDED TO THE SAME POTENTIAL AS THE WORKPIECE. THIS WILL PREVENT POSSIBLE DAMAGE TO THE WIRE FEED DRIVE.CAUSED BY ARCING. GROUNDING CAN BE ACCOMPLISHED THROUGH THE UNUSED THREADED MOUNTING HOLES IN THE DRIVE HOUSING.

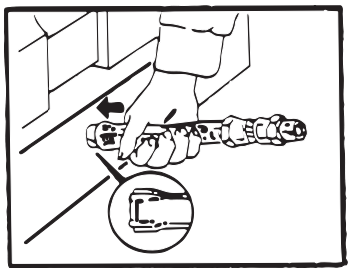




FITTING COMPONENTS

WIRE GUIDE MOUNTING

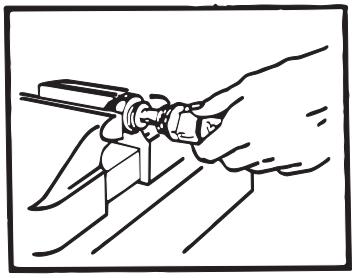
The guide mechanism portion of the wire guide assembly is made to accommodate a standard 1-3/8" (34.9mml diameter machine torch barrel (see Figure 2.4). Guide tips are available for specific wire sizes from .020" to .094" in diameter. The conduit, with proper liner, is attached to both the wire drive exit guide and the wire guide mechanism (see Table 1.1 for proper selection of these parts). Sharp bends in the conduit must be avoided. If shorter conduit lengths are required, see Section 2.51.

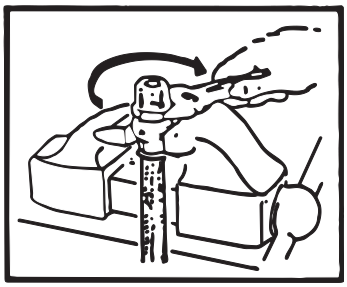


CONDUIT LENGTH ADJUSTMENT

The conduit as supplied *is* an assembled unit 36" (914 mm) in length. If shorter lengths are desired, the conduit may be cut and reassembled according to the following steps.

A) Disassemble existing fitting on one end. Save the fitting components. Wrap hose with masking tape at cut-off point and cut square to length through taped area using a sharp cut-off wheel or a fine-tooth hack saw. Remove tape and trim any loose wires flush with tube stock. Any burrs on the bore of the tube stock should be removed with a knife. Clean the hose bore. The wire braid will tend to “neck down” on this end. This is characteristic of wire braid hose and can be used to advantage in the assembly of the fittings. Slip the socket over the “necked down “ end of the hose, positioned approximately 3” (76 mm) from the end. Mount nipple hex in a vise. Work the hose bore over the nipple to size the tube and aid in separating the braid prior to fitting the sleeve. Remove hose from nipple.





B) Push the sleeve over the end of the tube and under the wire braid by hand. Complete positioning of the sleeve by pushing the hose end against a flat surface. Visually inspect to see that tube stock butts against the inside shoulder of the sleeve. Set the sleeve barbs into the Teflon tube by pushing the assembly tool or a round nose tapered punch into the end of the sleeve and tube.

Table 4, Wire Guide Assembly Parts list

SIGNAL	REMARKS
Remote Start/Stop	5-24 VDC, or contact closure signal to start
Inhibit	5-24 VDC, or contact closure signal to inhibit wire feed without stopping weld cycle
FWD/REV JOG	Contact closure signal to drive wire forward or reverse
Remote Speed Control	10K potentiometer or 0-1.235 volt signal for 0-300 ipm
Start Delay On	24 VDC lamp, or relay drive during start delay
Auto Feed	24 VDC lamp, or relay drive during automatic cycle wire feed
Motor Pulse	24 VDC low level signal pulse 1 pulse .0116 inches of wire travel.

C) Lubricate nipple and socket threads. For stainless steel fittings, use a molydisulfide base lubricant (e.g. .Molykote Type G) ; lubricants containing chloride are not recommended. Other material combinations use standard petroleum lubricants. Hold the nipple with hex in vise. Push hose over nipple with twisting motion until seated against nipple chamfer. Push socket forward, and hand start threading of socket to nipple.

D) Wrench-tighten nipple hex until clearance with socket hex is 1/32" or less. Tighten further to align corners of nipple and socket hexes. Clean and inspect all assemblies.

After the conduit is prepared, the liner may be cut to length and installed as shown in Figure 2.4 and explained in Section 2.4.

REMOTE CONTROLS

A number of remote capabilities are available with the DWF-4 system. On the rear panel of the control unit a connector is provided for remote operation. Optional remote controls are available such as the Remote Control Pendant, and Wire Feed Pulse Cycle Control. They have their own separate housings with cable and connector for mating directly to the control unit remote connector. See Section 6 for details.

The remote connector, in addition to providing for the remote control connections, provides the user access to other wire feeder signals. This may be used to incorporate the DWF-4 into a complete welding package system. The signals available are listed in Figure 3.3 and are described in more detail in Section 3.4. AP Automation also provides an optional pre-wired connector and shielded cable for connection to these signals. (See Sections 3.4 and 6.1).

CHANGING RETRACT DISTANCE

The wire retract distance which occurs at the end of a wire feed cycle comes preset from the factory at .512 inches. This distance can be changed through the range of .085 inches to 1.28 inches by changing the “E” jumpers. (See Table 4.4) .

OPERATION

PRECAUTIONS

Verify the following before connecting power to control unit.

A) Make certain the drive unit is grounded.

B) Check that all connections are secure and properly installed. All connections should be made to the torch and power supply before applying power to the control unit.

C) Should the cover of the control unit be removed for any reason, be sure the AC line cord is disconnected.

D) Check line voltage selector switch on rear panel for proper input voltage being used.

CAUTION THE CONTROL UNIT CAN OPERATE ON EITHER 100/120 VOLTS OR 208/230 VOLTS AC, 50 OR 60 HZ. BE SURE TO SELECT THE PROPER INPUT VOLTAGE ON THE REAR PANEL BEFORE CONNECTING

CONTROL DESCRIPTION -DWF-4

Refer to Figure 6 for location of the following front panel controls.

ON-OFF: Switches primary line voltage to the control unit. When power is ON, the power indicator will be illuminated.

MANUAL START - OFF - REMOTE START: In the center OFF position, a wire feed cannot be initiated; in the up MANUAL START position, a wire feed cycle is started. If this switch is placed down, in the REMOTE START position, a wire feed cycle can be initiated by applying an external signal to the proper pins of the remote connector on the rear panel. (See page ??? for complete details on REMOTE START.) The feed cycle stops for the DWF-4 system when either the REMOTE START (if used) or the MANUAL START switch is placed in the OFF position.

REVERSE -FORWARD JOG: Pressing the Jog Switch down, to the FORWARD position, will cause wire to feed out of the wire drive unit at the rate of 102.4 inches per min; (2601 mm/min) this speed is factory set and cannot be changed. Pressing the Jog Switch up, to the REVERSE position, will cause wire to be pulled back into the wire drive unit -also at 102.4 inches per min. (2601 mm/min). Releasing the switch will cause it to return to the center OFF position. In this way wire can be pre-positioned for the weld cycle.

START DELAY: Allows for a delay between the time a weld cycle is initiated and the time when wire feeding begins; START DELAY is preset table in .1 second increments, from 0.0 to 9.9 seconds.

STOP DELAY: Allows for a delay between the time when a weld cycle is terminated and the time when wire retracts then stops feeding. STOP DELAY allows for crater fill and is variable from 0 to 9.9 seconds in .1 sec. intervals.

WIRE SPEED: Digital display that indicates WIRE SPEED in inches per minute, in .1 inch per minute increments.

PUSH TO SET: Used in conjunction with the SPEED control to preset wire feed rate. Pressing this switch while rotating the speed control allows the operator to preset the wire feed rate without actually feeding wire, thereby eliminating waste of filler wire.

SPEED CONTROL: When in the STANDARD position, wire speed is controlled by the SPEED potentiometer located directly under the digital display on the control panel. When in the REMOTE position, wire speed is controlled by a REMOTE signal.

SEQUENCE OF OPERATION

After the DWF-4 has been installed, make sure all cables and connectors are properly mated. Check the line voltage selector switch on the rear panel to ensure it is set at the proper position to match the line voltage being used. The MANUAL/REMOTE switch should be in the OFF position. Back off thumbscrew on the drive unit to allow introduction of wire between drive rolls. Turn the power switch ON. The POWER indicator should illuminate and the digital display should read all zeros. Adjust thumbscrew to provide contact on wire. Activate the FORWARD Jog Switch and “guide” the filler wire into the wire drive entrance guide. The rollers will “pick up” the wire and begin feeding. Continue feeding the wire FORWARD until the wire is in position at the end of the guide tip. Use JOG FORWARD/REVERSE to adjust position.

Select the desired amount of START DELAY by setting the thumb-wheel switches to the appropriate value. Do the same for STOP DELAY or FEED TIME as applicable. Next, select the WIRE SPEED by pressing the PUSH TO SET button. While holding this button in, rotate the SPEED knob until the desired WIRE SPEED is indicated on the digital display; set the SPEED CONTROL selector switch to the STANDARD position. Positioning the MANUAL START/ REMOTE START switch to the MANUAL START position will now initiate a wire feed cycle.

The digital display will blink during START DELAY time. At the end of START DELAY, wire will begin to feed and the speed will be indicated on the display. Re-setting the MANUAL START switch to OFF will initiate the end of a wire feed cycle for the DWF-4. After STOP DELAY times out, the motor on the wire drive unit will reverse and retract the filler wire from the weld puddle; after the retract time, wire will stop feeding and the cycle is complete.

Figure 6, DWF-4 Rear Panel

REMOTE SIGNALS

The DWF-4 control unit has the capability of being controlled from a remote location. Seven signals are available as described in Table 4 as well as the following paragraphs.

Electrical connections are made as shown in Figures 7, 8, and 9. A pre-wired connector and cable is available from AP Automation (P/N 1074-0045).

REMOTE START is implemented by applying a signal between PIN C and F. PIN C is the positive terminal and PIN F is the negative terminal. This signal should be 5-24 VDC. The cycle will remain active as long as the signal is applied. The cycle terminates when the signal is removed.

The **INHIBIT FUNCTION** is implemented by applying a signal to PINS E and G; PIN E is positive and PIN G is negative. This signal should be 5-24 VDC. When the inhibit signal is applied, the wire feed is interrupted, but the cycle is not affected at its point in the cycle. When the inhibit signal is removed, the wire feed will continue. This feature is helpful for manual override or a pulse synchronization of wire to a pulsing power source.

REMOTE JOG FORWARD/REVERSE is implemented by the use of a SPDT switch. The center pole is connected to PIN D. The forward pole is connected to PIN D. The forward pole is connected to PIN L, and the reverse pole is connected to PIN K. This switch is now wired in parallel with the Jog switch on the front panel, and functions in the same manner.

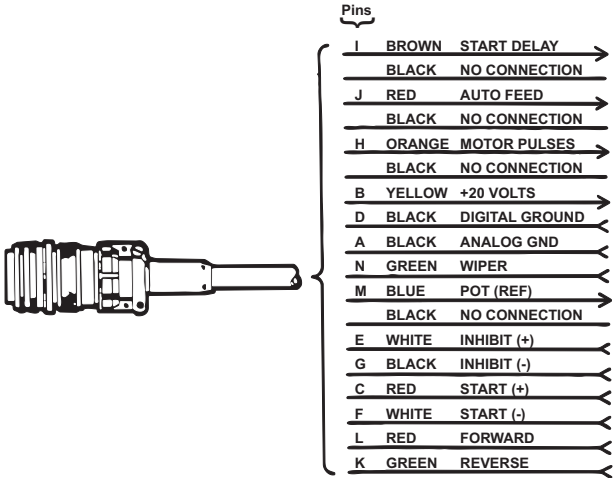
REMOTE WIRE SPEED control is implemented in much the same way. A 10K 1/2W potentiometer is connected with its wiper
(center pole) on PIN N. The plus reference voltage pole is connected to PIN M and the minus or ground pole is connected to PIN A. This pot is now selected by switching the speed control switch on the front panel (lower right corner of wire speed area) to the REMOTE position. Wire speed is now determined by setting this pot. The wire speed may also be controlled by a 0 to 1.235 volt signal (PIN A to PIN N which corresponds to O to 300 inch per minute wire speed).

REMOTE START DELAY signal is an output that signals when the system is in the DELAY timing mode. When the START DELAY times out, the signal is removed. This signal is 24 VDC 500mA max current. It may be used to light a remote indicator lamp or energize a relay coil. The signal connects to PIN I of the remote connector; return is ground (PIN D).

REMOTE AUTO FEED signal is an output that signals when the system is feeding wire automatically at the selected rate. Its output characteristics are the same as the remote start delay signal. The signal is on PIN J at the remote connector; return is ground (PIN D).

MOTOR PULSE signal is an output that signals each step of the feed motor. This signal is a 24V, 18-sec wide pulse with a 10K source resistance. It may be used for a tachometer output of wire length output. Each pulse represents .0116 inches of wire feed. The signal is on PIN H; return is ground (PIN D).

Figure 7, REMOTE WIRING CABLE



The remote start function requires a signal of +5 to 24 VDC. This signal is applied to PIN C of J3. The common is from the DWF-4. This signal is optically isolated from the DWF-4; therefore, the signal common need not be attached to the control unit ground. This signal would normally come through the normally open contacts of a relay that is activated at the start of a weld cycle, for example, the AP Automation Seam Tracker interface relay.

The inhibit function requires a signal of +5 to 24 VDC applied to PIN E of J3, and common connected to PIN G of J3. The inhibit signals are optically isolated from the DWF-4 control unit, and the common need not be connected to the control unit ground.

Figure 8, REMOTE START WIRING

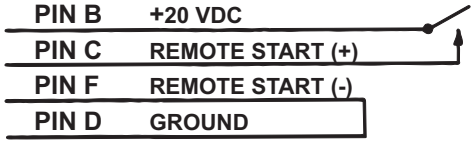
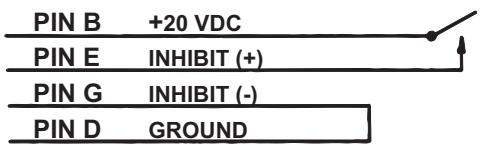


Figure 9, INHIBIT FUNCTION WIRING



MAINTENANCE AND REPAIR

MAINTENANCE REQUIREMENTS

The DWF-4 wire feed system has no special scheduled maintenance requirements. However, periodic inspection of control and wire drive is helpful in preventing equipment failures. Replace any worn or broken parts found. Periodic dust and oil removal from both the control and drive is recommended.

GENERAL PRECAUTIONS

Figure 10 shows a control unit for the DWF-4 system. Assemblies and parts that are authorized for user replacement are listed in Table 6. Should the user experience a problem and determine the defective part (see TROUBLESHOOTING, Table 5), the suggested repair procedure is to remove and replace the defective part. Figure 11 and Table 7 provide a detailed parts breakdown of the circuit board assembly.

CAUTION WHEN INSPECTING OR REPAIRING THE CONTROL UNIT ASSEMBLY, DISCONNECT AC POWER FROM THE UNIT BEFORE REMOVING THE COVER TO PREVENT ELECTRICAL SHOCK.

CONTROL UNIT CALIBRATION

The control unit has been calibrated and fully tested before leaving the factory. It is unlikely that it would require adjustment, however, if the need for re-calibration arises, there are three adjustments that can be made that affect wire speed and delay time accuracy. The only test equipment required is a good quality frequency counter of known accuracy. Refer to Figure 11 for easy location of the potentiometers and test points. Two adjustments, R2 and R7 affect wire speed accuracy. Perform the following steps to calibrate the control unit.

A) Connect the frequency counter to TP 14.

B) Rotate the speed control knob on the front panel to its minimum speed setting, i.e. fully counter-clockwise. Now adjust R7 until the frequency counter indicates zero.

C) Repeat Step B). There is only one adjustment to be made on the time base osc. -R10; it sets the start and stop delay accuracy and the wire speed readout accuracy.

D) Connect the frequency counter to TP 2, and adjust R10 for a reading of 2560 Hz ± 1 Hz.

NOTE

REPEAT STEPS B) THROUGH D) IF THE ADJUSTMENT ON R10 IS CHANGED.

Table 5, Troubleshooting Guide

TROUBLE INDICATION	REPAIR STEPS
1 Power ON lamp does not light.	**a** Verify that power cord is plugged in and circuit breaker is reset.
	b Verify that all plugs are installed in the circuit board.
	c Check +20v (TP 9, Figure 11). Replace board if necessary.
	d Check lamp; replace if necessary.
2 Digital display does not light.	**a** Repeat Steps a, b and c above.
	b Check +5v (TP 12, Figure 11). Replace board if necessary.
	c Replace digital display board
3 Incorrect START/STOP delays	**a** Repeat Step 1-b above.
	b Recalibrate (see Section "Control Unit Calibration").
	c Replace thumbwheel assembly or circuit board.
4 Feed cycle does not start	**a** Verify that MANUAL START/OFF/REMOTE switch is in correct position.
	b Repeat Step 1-b above
	c Replace circuit board.
5 Incorrect wire feed speed	**a** Verify that SPEED CONTROL switch is in correct position.
	b Repeat Step 1-b and 3-b above.
	c Check input signal (TP 15, Figure 11). Replace speed pot or circuit board if necessary.
	d Verify that thumbscrew is fully seated. Exception: Back off one full turn when using .020" dia. wire.
	e Verify that correct drive rolls for wire diameter are installed (see Table 1).
	f Check roller surface; if excessively worn, slip off urethane wheels and replace.
6 Motor turns but wire does not feed.	**a** Verify that drive unit is connected to control.
	b Repeat Step 1-b above.
	c Check motor and cable continuity. It should be about 1.5 ohms from PIN A, D, E and C referenced to pin B on motor connector. Repair or replace if necessary.
	d Check motor current (speed less than 10 ipm = 80-110 mv between TP 7 and TP 8 - see Figure 11). Replace circuit board if necessary.
	e Loosen feed tension adjustment knob completely. Verify wire runs smoothly off wire reel and through guides and conduit.
	f Verify thumbscrew is properly adjusted. Exception: Back off one full turn when using .020" dia. wire.
	g Verify correct drive rolls for wire diameter. (See Table 1) .
	h Check roller surface; if excessively worn, slip off urethane wheels and replace.

DRAWING & PARTS LIST

Figure 10, Control Unit Assembly, PN 0600-0217

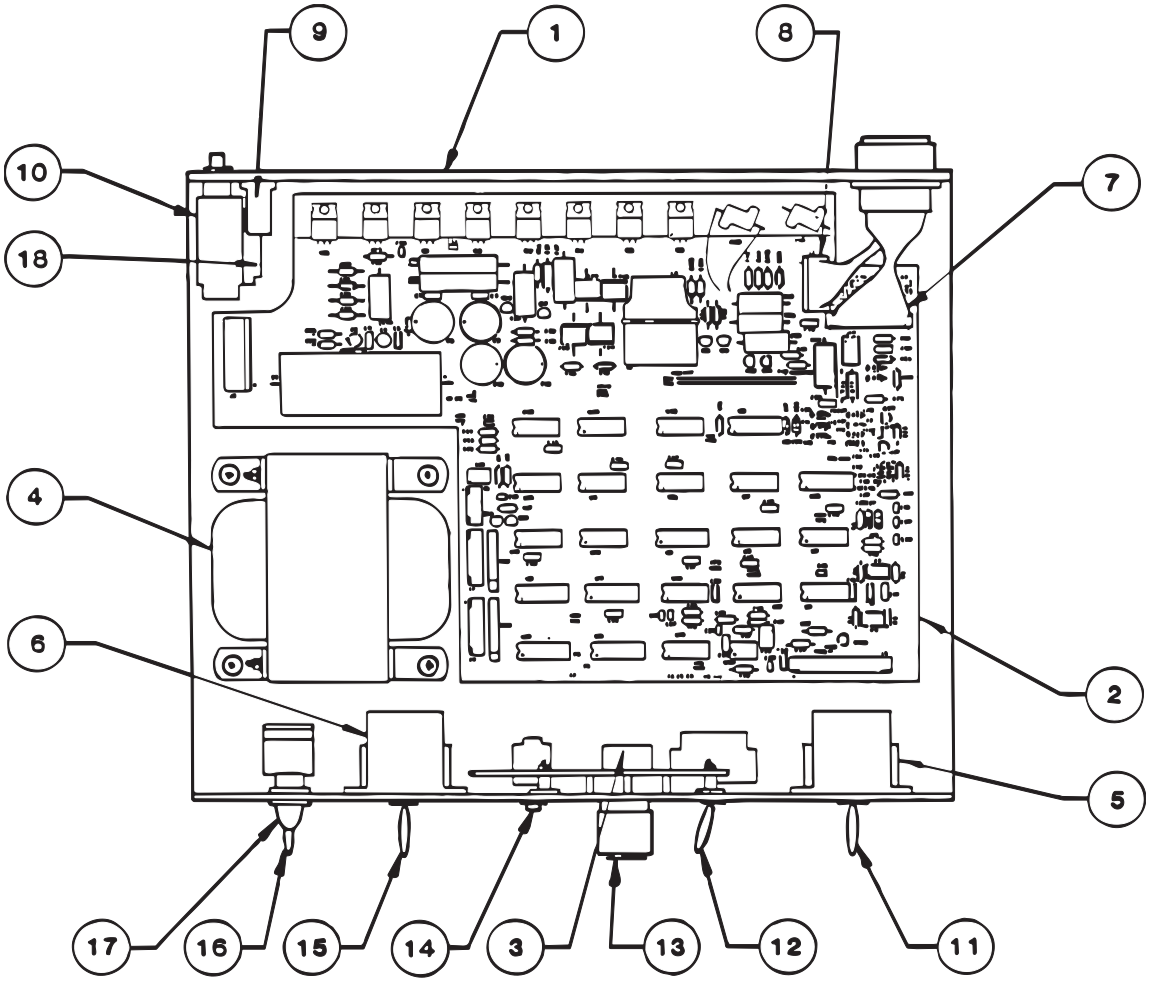


Table 6, Parts List for Control Unit Assembly

ITEM	QTY	PART No.	DESCRIPTION
1	1	1066-0009	CHASSIS ASSY
2	1	1062-0007	PWB DWF-4 CONTROLLER/DRIVER
3	1	1062-0015	PWB DWF-4 DISPLAY AND DRIVER
4	1	1066-0041	TRANSFORMER ASSY, DWF-4
5	1	1066-0033	ASSY, THUMBWHEEL SWITCH
6	1	1066-0025	ASSY, THUMBWHEEL SWITCH
7	1	1074-0011	CABLE ASSY,DWF-4 INTERNAL INTERFACE
8	1	1074-0029	CABLE ASSY,DWF-4 DRIVE INTERFACE
9	1	2066-0139	SWITCH, JOG FWD/REV OR 120/140 VOLT
10	1	2120-0131	CIRCUIT BREAKER ETA TYPE, 1 AMP
11	1	2060-0047	SWITCH, JOG FWD/REV
12	1	2060-0071	SWITCH, SPEED CONTROL,STAND/REMOTE
13	1	2624-0051	POT 10K,10 TURN,SPEED CONTROL
14	1	2062-0056	SWITCH, MOMENTARY, PRESS TO SET
15	1	2060-0055	SWITCH, REMOTE START/MANUAL START
16	1	2060-0063	SWITCH, POWER ON/OFF
17	1	941000-011	LAMP POWER ON INDICATOR
18	1	2120-0123	RFI FILTER AC INPUT LINE

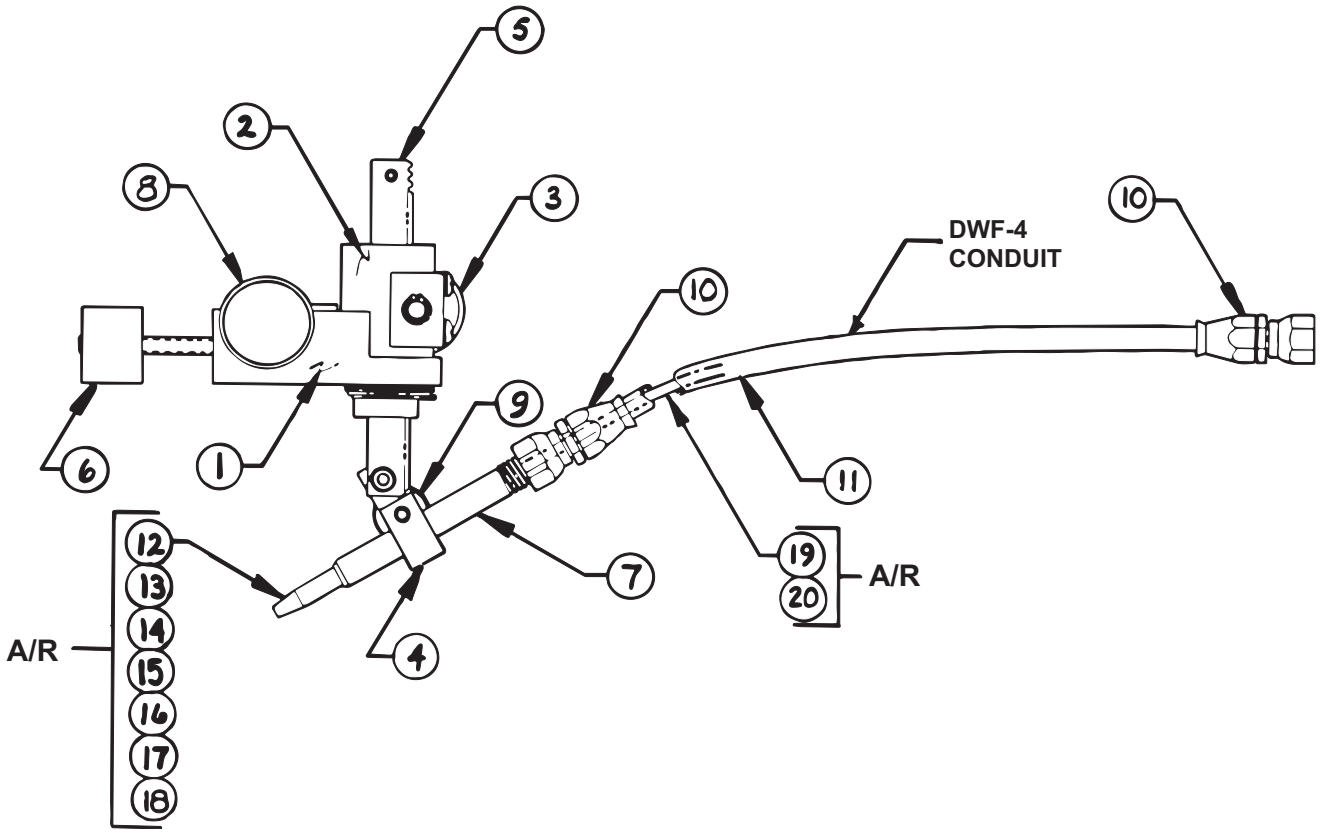


Figure 5, Wire Guide Assembly

Table 3, Wire Guide Assembly Parts list

ITEM	QTY	PART No.	DESCRIPTION
1	1	1070-1066	BODY MANIPULATOR MACHINED
2	1	1070-1074	PIVOT -WIRE MANIPULATOR
3	1	1070-1023	KNOB, VERT. ADJ -WIRE MANIP.
4	1	1070-1031	CLAMP, WIRE MANIPULATOR
5	1	1076-1035	RACK -WIRE MANIPUALATOR
6	1	1070-0167	CLAMP , TORCH
7	1	1070-1091	COUPLING, MANIPULATOR, TWECO
8	1	2408-1079	SCREW, THUMB 10-32 ST STEEL
9	1	2408-1296	SCREW, THUMB
10	2	1076-0097	FITTING MODIFIED
11	1	2380-0187	HOSE, FLEX -TEFLON LINED
12	1	2360-1567	TIP, WIRE GUIDE, .020
13	1	2360-1575	TIP, WIRE GUIDE, .035
14	1	2360-1583	TIP, WIRE GUIDE, .045
15	1	2360-1591	TIP, WIRE GUIDE, .062
16	1	2360-1605	TIP, WIRE GUIDE, .030
17	1	2360-1613	TIP, WIRE GUIDE, .052
18	1	2360-0099	TIP, WIRE GUIDE, .094
19	A/R	2360-0951	LINER, CONDUIT
20	A/R	2360-0960	LINER, CONDUIT

Figure 10, Controller/Driver PWB Assembly, PN 1062-0007

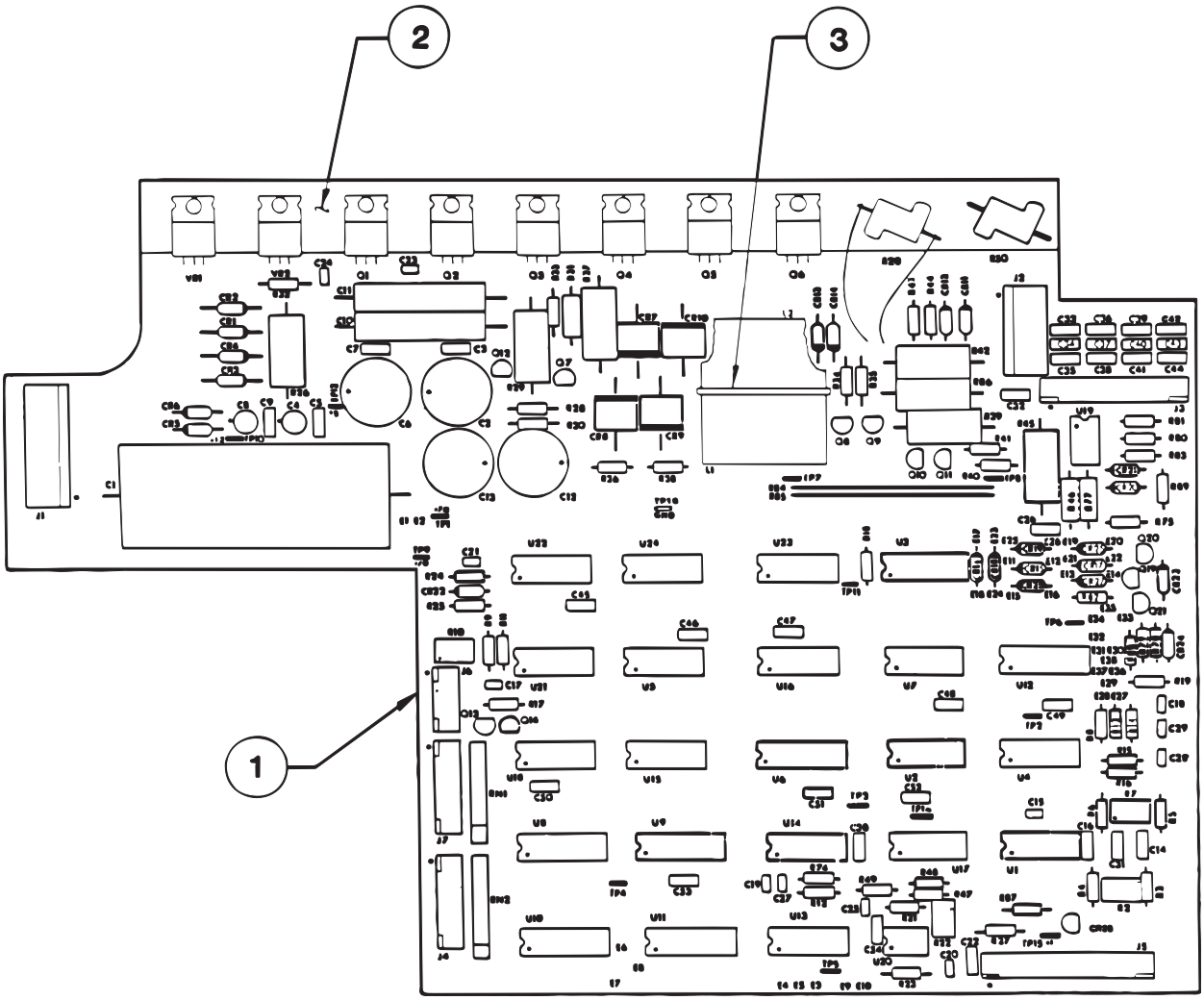


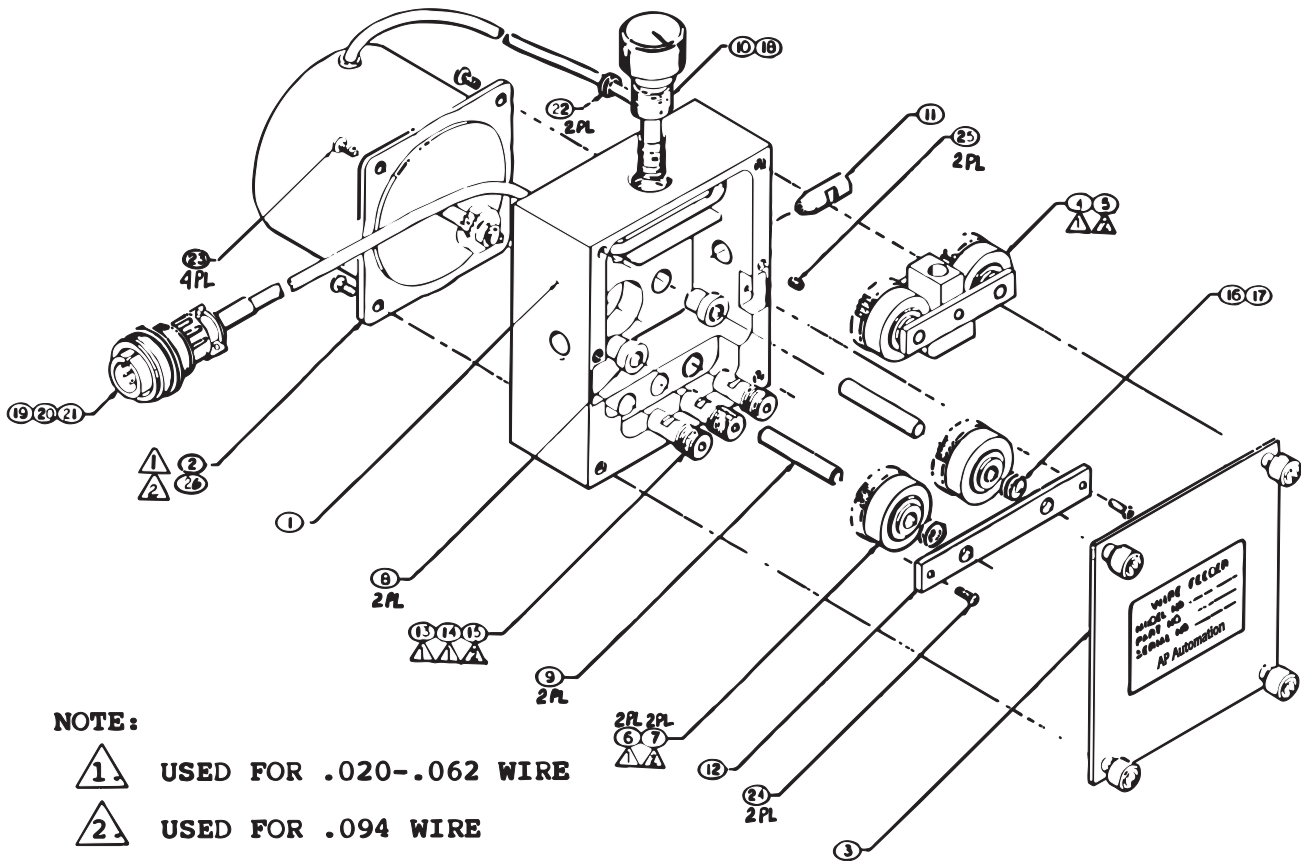
Table 6, Parts List for Controller/Driver PWB Assembly

QTY	PART No.	DESCRIPTION	REF. DESIGNATION
1	1075-0041	PWB,DRILLED -CONT/DRVR	Item 1
1	1175-0044	HEATSINK,SWITCH -PWR DRIVE	Item 2
1	2208-0571	CONN,RECT,PLUG (14CKT)	J3
2	2208-0563	CONN,RECT,PLUG (9CKT)	J4,J7
1	1108-0555	CONN,RCT,PLUG (6CKT)	J6
1	2208-0385	CONN,RECT,PLUG (8CKT)	J1
1	2208-0377	CONN,RECT,PLUG (6CKT)	J2
1	2208-0580	CONN,RECT,PLUG (16CKT)	J5
1	2820-0072	IC V TO FREQ CONVERTER	U1
4	2800-0251	IC,HEF4510BP	U8-U11
1	2810-0311	IC,TIMER	U20
1	2800-0375	IC,MCI4518BCP	U3
1	2800-0626	IC,MCI4020BCP	U6
1	2800-0227	IC,CD4085B3	U23
2	2800-0065	IC,CD4013B3	U7,U22
3	2800-0359	IC,MC14093BCP	U16-18
3	2800-0022	IC,CD4001B3	U2,U13,U21
1	2800-0014	IC,CD4001A3	U5

Table 6, Continued, Parts List for Controller/Driver PWB Assembly

QTY	PART No.	DESCRIPTION	REF. DESIGNATION
1	2800-0324	IC,MC14077BCP	U15
3	2800-0421	IC,MC14584BCP	U4,U14,U24
1	2820-0161	IC,OPTO ISOLATOR	U19
1	2718-0060	REG,+15V,U17812UC	VR1
1	2718-0043	REG,+5V,UA78057C	VR2
2	1066-0017	CORE ASSY	L1,L2
1	1070-0019	INSULATOR,CORE	Item 3
3	2708-0162	XSTR	Q1,Q3,Q4
3	2708-0138	XSTR,POWER,80V	Q2,Q5,Q6
2	2712-0091	XSTR , NPN MPS A05	Q13,Q14
4	2712-0105	XSTR,NPN FREQ 100	Q7,Q8,Q9,Q12
5	2712-0121	XSTR,PNP FRQ 100	Q1Q,Q11,Q19-21
1	2700-0037	DIODE	CR28
4	2702-01.51	DIODE,RECT 5A 100V	CR7-CR10
6	2700-0029	DIODE,SIGNAL	CR18, CR20-22,25,CR27
4	2702-0097	DIODE,RECT	CR1-CR4
8	2702-0038	DIODE,RECT 1.0A 100V	CR5,CR6, CR11-CR14, CR23,CR24
1	2502-0278	CAP,ELCTLT 1000UF 75VDC	C1
4	2502-0057	CAP,ELCTLT 1000UF 35V	C2,C6, C.I2,C13
2	2504-0040	CAP,TANT,10UF 25V	C4,C8
2	2506-0156	CAP,3 MFD, 100V, 10%	C10,C11
32	2500-0307	CAP,CER .1UF 100V	C3,C5,C7, C9,C14,C16, C22,C26, C30-C41, C43-C54
1	2800-0260	IC,CD4516BE	U12
4	2500-0218	CAP,CER .01UF 50V	C20,C27-C29
1	2500-0161	CAP,CER .001UF 100V	C17
7	2500-0196	CAP,CER .001UF 200V	C15,C18,C19, C21,C23-C25
2	2614-0013	RESISTOR NETWORK-SIP 47K	RN1,RN2
2	2622-0114	POT,TRMR, 10K	R10,R22
1	2622-0131	POT, TRMR, 20K	R7
1	2622-0106	POT,TRMR, 1K	R2
1	2606-3442	RES MF 3.83K 1/10W 1%	R3
1	2606-4872	RES MF 118K 1.10W 1%	R9
1	2606-4376	RES MF 35.7K 1/10W 1%	R11
1	2606-3931	RES MF 12.4K 1/10W 1%	R21
1	2606-4651	RES MF 69. 8K 1/10W 1%	R25
15	2600-3709	RES CARB 10K 1/4W 5%	R4-R6,R8, R12-R16,R18,R47-49,R75,R83
2	2600-2800	RES CARB 1.0K 1/4W 5%	R17,R87
7	2600-3822	RES CARB 22K 1/4W 5%	R19,R28,R30, R34,R35,R40,R41
1	2600-2e51	RES CARB 1.5K 1/4W 5%	R23
1	2600-2907	RES CARB 2.0K 1/4W 5%	R24
3	2600-2311	RES CARB 510 OHMS 1/4 5%	R27,R32,R33
4	2600-3211	RES CARB 5.1K 1/4W 5%	R36,R38,R43,R44
1	2600-5507	RES CARB 1.00M 1/4W 5%	R74
1	2600-4071	RES CARB 47K 1/4W 5%	R82
2	2600-3725	RES CARB 12K 1/4W 5%	R78,R79
2	2600-1374	RES CARB 47 OHMS 1/4W 5%	R80,R81
2	2600-3873	RES CARB 27K 1/4W 5%	R88,R89
1	2602-2622	RES CARB 820 OHMS 1/2W 5%	R31
2	2602-2801	RES CARB 1. 0AR 1/2W 5%	R46,R77
1	2604-1694	RES CARB 3. 3AR 2W 5%	R26
1	2604-1716	RES CARB 3.9K 2W 5%	R29
4	2604-1546	RES CARB 680 OHMS 2W 5%	R37,R39,R42,R86
1	2604-1473	RES CARB 330 OHMS 2W 5%	R45
4	3036-0001	WIRE NI CHROME	R84,R85
1	2610-0917	RES WW 5 OHMS SW 3%	R20
15	2340-0324	LUG,TEST POINT	TP1-TP12,14,15

QTY	PART No.	DESCRIPTION	REF. DESIGNATION
4	2500-0218	CAP,CER .01UF 50V	C20,C27-C29
1	2500-0161	CAP,CER .001UF 100V	C17
7	2500-0196	CAP,CER .001UF 200V	C15,C18,C19, C21,C23-C25
2	2614-0013	RESISTOR NETWORK-SIP 47K	RN1,RN2
2	2622-0114	POT,TRMR, 10K	R10,R22
1	2622-0131	POT, TRMR, 20K	R7
1	2622-0106	POT,TRMR, 1K	R2
1	2606-3442	RES MF 3.83K 1/10W 1%	R3
1	2606-4872	RES MF 118K 1.10W 1%	R9
1	2606-4376	RES MF 35.7K 1/10W 1%	R11
1	2606-3931	RES MF 12.4K 1/10W 1%	R21
1	2606-4651	RES MF 69. 8K 1/10W 1%	R25
15	2600-3709	RES CARB 10K 1/4W 5%	R4-R6,R8, R12-R16,R18, R47-49,R75,R83
2	2600-2800	RES CARB 1.0K 1/4W 5%	R17,R87
7	2600-3822	RES CARB 22K 1/4W 5%	R19,R28,R30, R34,R35,R40,R41
1	2600-2e51	RES CARB 1.5K 1/4W 5%	R23
1	2600-2907	RES CARB 2.0K 1/4W 5%	R24
3	2600-2311	RES CARB 510 OHMS 1/4 5%	R27,R32,R33
4	2600-3211	RES CARB 5.1K 1/4W 5%	R36,R38,R43,R44
1	2600-5507	RES CARB 1.00M 1/4W 5%	R74
1	2600-4071	RES CARB 47K 1/4W 5%	R82
2	2600-3725	RES CARB 12K 1/4W 5%	R78,R79
2	2600-1374	RES CARB 47 OHMS 1/4W 5%	R80,R81
2	2600-3873	RES CARB 27K 1/4W 5%	R88,R89
1	2602-2622	RES CARB 820 OHMS 1/2W 5%	R31
2	2602-2801	RES CARB 1. 0AR 1/2W 5%	R46,R77
1	2604-1694	RES CARB 3. 3AR 2W 5%	R26
1	2604-1716	RES CARB 3.9K 2W 5%	R29
4	2604-1546	RES CARB 680 OHMS 2W 5%	R37,R39,R42,R86
1	2604-1473	RES CARB 330 OHMS 2W 5%	R45
4	3036-0001	WIRE NI CHROME	R84,R85
1	2610-0917	RES WW 5 OHMS SW 3%	R20
15	2340-0324	LUG,TEST POINT	TP1-TP12,14,15



NOTE:

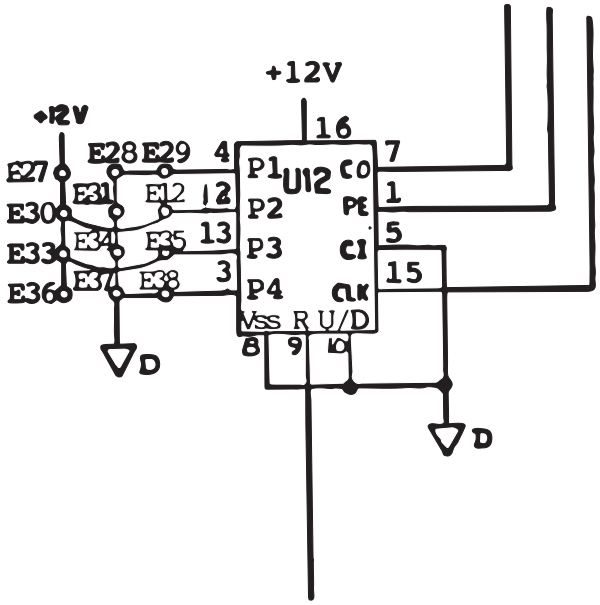
1. **USED FOR .020-.062 WIRE**
2. **USED FOR .094 WIRE**

ITEM No.	QTY	PART No.	DESCRIPTION
1	1	1066-0076	BOGIE ASSEMBLY, DWF-4
2	1	1066-0106	DRIVE MOTOR ASSEMBLY, DWF-4
3	1	1066-0114	COVER ASSEMBLY, DRIVE, DWF-4
4	2	1066-0084	URETHANE ROLLER ASSEMBLY
5	1	1070-0035	HOUSING, WIRE FEEDER
6	1	1072-0061	RETAINER, DRIVE GEAR
7	2	1070-0043	BUSHING, GEAR SHAFT
8	2	1076-0020	SHAFT , BOGIE
9	1	1070-0051	GUIDE, WIRE- EXIT
10	1	1070-0060	GUIDE, WIRE -INLET
11	1	1070-0078	KNOB, SCREW
12	1	2204-0090	CLAMP , BACKSHELL
13	1	2200-0306	CONNECTOR, CIRCULAR STR PLUG
14	A/R	2144-0027	TUBING SHRINK, BLACK
15	1	2360-1779	SPRING COMPRESSION
16	2	2040-0013	STRAIN RELIEF -PLASTIC
17	A/R	2144-0043	TUBING SHRINK, BLACK
18	A/R	2144-0035	TUBING SHRINK, BLACK
20	4	2402-0801	SCREW SCH HEX 10-24 X .375
21	2	2408-0935	SCREW CONE PT. 10-24 X .50
22	2	2400-0346	SCREW PANHD PHIL 6-32 X 3/8
23	2	2360-0528	SPACER, BEARING .020 THICK
24	2	2360-0536	SPACER, BEARING .032 THICK
25	8	2140-0009	CABLE, 6 COND, 22 AWG
29	1	1070-0086	GUIDE, WIRE EXIT
30	1	1075-0326	NAMEPLATE-DIGITAL CONTROL
31	1	1066-0416	DRIVE MOTOR ASSEMBLY H.D. .094W
32	1	1066-0122	BOGIE ASSEMBLY DWF-4 .O94W
33	1	1066-0092	URETHANE ROLLER ASSEMBLY .094W
34	1	1070-0116	GUIDE, WIRE EXIT .O94W

The standard setting for the DWF-4 is .512". However, the following lengths may be obtained by inserting jumpers from PI, P2, P3 and P4 on the U12 IC Circuit to +12V and ground as shown:

LENGTH DESIRED		JUMPER CONNECTION TO +12V AND GROUND FROM:			
(INCHES)	(MM)	P1	P2	P3	P4
0.085	2.15	+12	GND	GND	GND
0.170	4.32	GND	+12	GND	GND
0.256	6.50	+12	+12	GND	GND
0.341	8.67	GND	GND	+12	GND
0.427	10.86	+12	GND	+12	GND
0.512*	13.00	GND	+12	+12	GND
0.597	15.16	+12	+12	+12	GND
0.683	17.35	GND	GND	GND	+12
0.768	19.51	+12	GND	GND	+12
0.853	21.67	GND	+12	GND	+12
0.939	23.85	+12	+12	GND	+12
1.024	26.00	GND	GND	+12	+12
1.109	28.17	+12	GND	+12	+12
1.195	30.35	GND	+12	+12	+12
1.280	32.51	+12	+12	+12	+12

* Standard



NOTE

REFER TO FIGURE ??? "SCHEMATIC DIAGRAM DWF-4 CONTROL UNIT"

SPEED CONTROL CIRCUITS

There are two speed control circuits in the DWF-4 control unit. One is for the Jog and Retract functions, and is a preset speed. The other is for wire feed during the weld cycle and this speed is variable.

Variable-speed motor pulses originate at U1, which is a voltage-controlled oscillator. The output at PIN 14 is a square wave whose frequency is determined primarily by the setting of R1 (the speed control pot) located on the front panel. The upper and lower frequency limits of this oscillator are set by pots R2 and R7 respectively. When the proper logic conditions exist in the gating circuits, this signal is sent through U2 to 03 where it is divided by 70. Each one of 70 pulses is then sent to U4 where it is squared up and routed to U22, which in conjunction with U23 generates the four separate phases for the motor in the wire drive unit.
Fixed speed motor pulses, as required for the Jog and Retract functions are generated at U5. This is referred to as the time base osc. and operates at a fixed frequency.

When selected by the proper logic via the same route as the variable pulses described in the preceding paragraph. The basic frequency of this osc. is 10240 Hz; and this results in a fixed motor speed that feeds wire at 102.4 inches per minute (2601 mm/min)

DELAY TIMER CIRCUITS

Start delay timers 08 and 09 are preset table counters with thumb-wheel switches connected to their Jam inputs. These inputs are weighted 1, 2, 4 and 8; and by selecting a number on the thumb-wheel switch, this BCD value is present at the Jam inputs. A 10Hz clock signal from 06 is applied to the clock inputs (PIN 15) of each counter. When either a manual or remote signal is applied to the control unit to start a cycle, 014 PIN 8 goes to a logic low level. This low is applied to count clock pulses. Assume that 3.6 seconds has been selected on the thumb-wheel switch for a start delay time. When the sixth clock pulse appears at U9, its C0 goes low, enabling U8 at CI, PIN 5. When coincidence is detected by internal comparators, U8 C0 at PIN 7 goes low and this signal is gated through U13, U21 and U18 to produce the auto feed time signal which allows motor pulses to reach the motor.

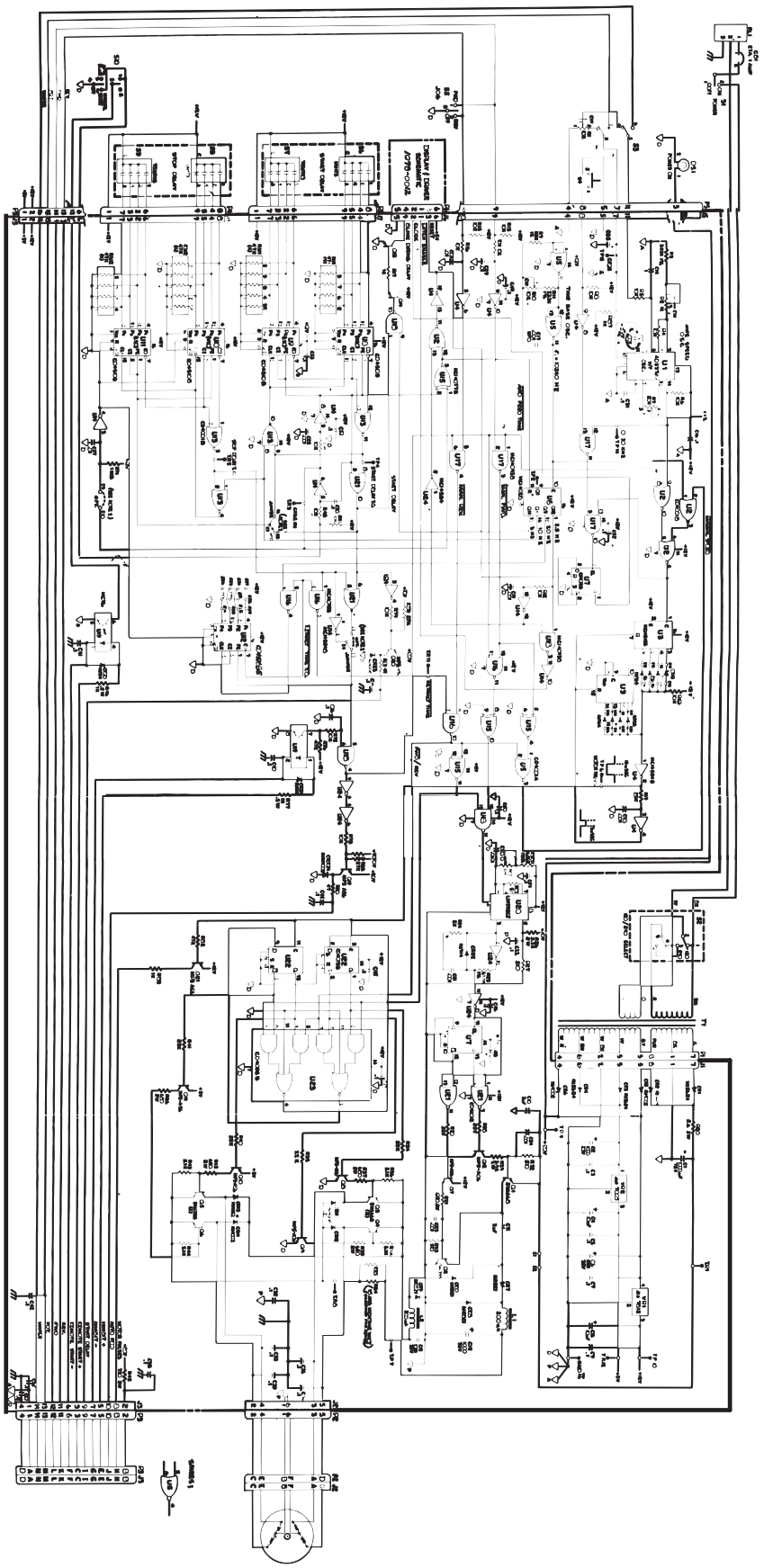
Stop delay operates in much the same manner, except it is initiated by the removal of the manual or remote start cycle signal. Its delay time is used to hold the auto feed time signal on until its delay period has timed out.

DIGITAL DISPLAY CIRCUIT

The wire speed indicator is a digital display composed of four LED's and an IC (U1) that contains four counters, latches, decoders and drivers. It also contains its own osc. that drives its internal multiplexing circuits. The blink during start delay is implemented by U18, Q14 and Q13. After start delay has timed out, U18 PIN 10 remains High; and through Q13 a ground is provided for the transistors on the display board.

MOTOR POWER SUPPLY CIRCUIT

The motor power supply circuit is composed of two main sections. U20 is an oscillator which, through U24, U7 and UJ21 drives Q1 and Q2 in a chopper configuration. This chopped DC is then rectified by diodes CR7, CR8, CR9 and CR10 into the positive and negative voltages, which serve as the supply for Q3, Q4, Q5 and Q6. The four phases required for the separate motor windings are generated by U22 and U23. Transistors Q8, Q9, Q10 and Q11 are drivers for transistors Q3 through Q6. This circuit arrangement results in one motor winding being energized at all times; this serves as a brake while wire is not being fed.



General Terms & Conditions

These general terms and conditions of sale supersede all printed terms on the customer's purchase order or any other inconsistent terms unless mutually agreed to in writing prior to acceptance of the customer's purchase order by Arc Products.

Order Acceptance

No order shall be effective and enforceable against Arc Products unless a duly authorized agent of Arc Products accepts it.

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All prices listed in brochures, price lists or other publications issued by Arc Products are subject to change without notice. Prices for parts and equipment shall be those in effect at the time of order placement.

Discounts

Discounts from published suggested list prices shall be granted to all authorized Distributors in accordance with the categories and schedules described in the most recent Arc Products Price Guide.

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There is a $25.00 minimum billing for standard orders shipped from San Diego, California.

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All prices are F.O.B. our factory in San Diego, California, USA. Small package charges will normally be prepaid and added to the invoice as a separate charge. Truck shipments will normally be sent freight collect. Customer may specify method of shipment and carrier, otherwise freight will be sent best way.

Terms of Payment

Net 30 days from date of shipment.

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If Arc Products deems its customer's credit insecure, Arc Products may cancel any outstanding orders for the customer and/or revoke any further extension of credit. Arc Products shall be entitled to a late payment charge on any past due amounts at the maximum rate provided by law not below 1½% per month.

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All products are sold F.O.B. San Diego, California and title to those products passes to the customer at the time the carrier accepts shipment. Arc Products shall have no obligation covering transportation or any other risks. Any claim for loss or damage must be filed by the customer with the carrier. Arc Products will furnish copies of suitable bills of lading and will also issue a tracer on any shipment at the request of the customer.

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- Cancellation of orders for standard items ordinarily carried for stock shipments will not be subject to cancellation charges, provided notice is given prior to scheduled shipping date.

Special Items:

- Cancellation of orders for extraordinary quantities of standard items or any special items not normally stocked by Arc Products will be subject to cancellation charges.

Cancellation charges are as follows:

- The buyer is responsible for payment of any portion of the product that has been purchased or manufactured by Arc Products.
- The buyer is also responsible for payment of any cancellation expenses incurred by Arc Products.

Return of Unused Parts:

Conditions of Return:

- The parts must be new, unused and undamaged.
- Certain specialty items, custom built items, or special modified items may not be returnable.
- Parts must be returned within 6 months of original shipping date.

- Prior approval must be obtained from Arc Products. At that time, Arc Products will issue a Return Authorization (RA) number for its return. This number must appear on the outside of the package and on any accompanying paperwork. Upon inspection and acceptance, a restocking charge, if applicable, may be assessed for any unusual cost for refurbishment. Any applicable freight charges will be applied before credit is issued.

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Arc Products' best efforts will be used to fill all orders. Lead-time, however, will vary according to inventory levels, manufacturing schedules and other considerations. Delivery dates are estimated. Under no circumstances will Arc Products be liable to anyone for any special or consequential damages whether based on lost goodwill, lost resale profits, work stoppage, impairment of other goods, or otherwise and whether arising out of breach of warranty, breach of contract, negligence or otherwise.

Limited Warranty

Arc Products warrants to the user that all new and rebuilt equipment furnished by Arc Products to be free from defects in material and workmanship as of the time and place of delivery by Arc Products. The limited warranty is for the periods indicated below or where otherwise specified in each product group. With respect to trade accessories or other items manufactured by others, such items are sold subject to the warranties of their respective manufacturers, if any.

Description	Warranty
Component Parts	***30 days***
Printed Circuit Board	***120 days***
Repair Work (limited to repair)	***90 days***
New Equipment	***2 years***
Rebuilt Equipment	***1 year***
Remote Controls, Torches, and Accessories	***90 days***
Consumables	***Exempt***

In the case of Arc Products' breach of warranty or any other duty with respect to quality of goods, the exclusive remedies shall be at Arc Products' option. (1) Repair or (2) Replacement or (3) The reasonable cost of repair or replacement at an authorized Arc Products' service station, or (4) Payment of or credit for the purchase price upon return of goods. Upon notice of apparent defect or failure, Arc Products shall instruct the claimant on the warranty claim procedures to be followed.

The warranty is void if Arc Products determines that the product and/or associated hardware has been used in a manner for which it was neither designed, nor manufactured; improperly installed, improperly maintained, modified, or otherwise ill-treated. Transportation charges to send the product(s) to an authorized repair facility or to Arc Products shall be the responsibility of the customer. All returned goods shall be at the customer's risk and expense. Transportation charges to send the product(s) back to the customer will be Arc Products' responsibility.

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Any warranty not provided herein, and any implied warranty, guarantee or representation as to performance, and any remedy for breach of contract which, but for this provision, might arise by implication, operation of the law, custom of trade or course of dealing, including any implied warranty of merchantability or of fitness for particular purpose, with respect to any and all products furnished by Arc Products is excluded and disclaimed by Arc Products.

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Arc Products maintains a product repair facility for all products at its factory located at 1245 30th St., San Diego, CA 92154. Whenever possible, equipment sent in for repair or evaluation should include appropriate documentation, diagnosis or explanation of failure or malfunction. Additionally, please include a contact name, phone and fax number. A detailed report and request for repair authorization will be provided.

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